

# Claims

- [c1] 1.A production planning method comprising:  
identifying substitute components that can be used in place of original components in assemblies; and providing restrictions on use of said substitute components to subsets of assemblies, such that a substitute component may be substituted for an original component in a first assembly and may not be substituted for said original component in a second assembly.
- [c2] 2.The method in claim 1, wherein said restrictions are based on one of client requirements and engineering constraints.
- [c3] 3.The method in claim 1, wherein said restrictions provide for multiple substitutions of said substitute components for original components in said assemblies.
- [c4] 4.The method in claim 1, wherein said substitute components perform the same function and are structurally different.
- [c5] 5.The method in claim 1, wherein said substitute components are used in place of original components to in-

crease manufacturing efficiency.

- [c6] 6.A production planning method comprising:
- identifying substitute components that can be used in place of original components in assemblies;
  - providing restrictions on use of said substitute components to subsets of assemblies, such that a substitute component may be substituted for an original component in a first assembly and may not be substituted for said original component in a second assembly;
  - formulating said restrictions as mathematical expressions for each substitute component; and
  - solving for optimum material substitutions using said mathematical expressions.
- [c7] 7.The method in claim 6, wherein said restrictions are based on one of client requirements and engineering constraints.
- [c8] 8.The method in claim 6, wherein said mathematical expressions provide for multiple substitutions of said substitute components for original components in said assemblies.
- [c9] 9.The method in claim 6, wherein during said solving process said mathematical expressions set the quantity

of substitutions to be no greater than a multiple of the number of associated assemblies.

[c10] 10. The method of claim 6, wherein said mathematical expressions comprise linear mathematical expressions.

[c11] 11. The method in claim 6, wherein said substitute components perform the same function and are structurally different.

[c12] 12. The method in claim 6, wherein said substitute components are used in place of original components to increase manufacturing efficiency.

[c13] 13. A production planning method comprising:  
identifying substitute components that can be used in place of original components in assemblies;  
providing restrictions on use of said substitute components to subsets of assemblies, such that a substitute component may be substituted for an original component in a first assembly and may not be substituted for said original component in a second assembly;  
formulating said restrictions as mathematical expressions for each substitute component; and  
combining mathematical expressions of components that have the same restrictions.

- [c14] 14.The method in claim 13, wherein said restrictions are based on one of client requirements and engineering constraints.
- [c15] 15.The method in claim 13, wherein said mathematical expressions provide for multiple substitutions of said substitute components for original components in said assemblies.
- [c16] 16.The method in claim 13, further comprising solving for optimum material substitutions using said mathematical expressions,  
wherein during said solving process said mathematical expressions set the quantity of substitutions to be no greater than a multiple of the number of associated assemblies.
- [c17] 17. The method of claim 13, wherein said mathematical expressions comprise linear mathematical expressions.
- [c18] 18.The method in claim 13, wherein said substitute components perform the same function and are structurally different.
- [c19] 19.The method in claim 13, wherein said substitute components are used in place of original components to increase manufacturing efficiency.

[c20] 20.The method in claim 13, further comprising removing said restrictions for components that are acceptable to all assemblies.

[c21] 21.A production/distribution planning method comprising:

- identifying substitute part numbers that can be used in place of original part numbers;
- providing restrictions on use of said substitute part numbers to subsets of customers, such that a substitute part number may be substituted for an original part number when used by a first customer and may not be substituted for said original part number when used by a second customer;
- formulating said restrictions as mathematical expressions for each substitute part number; and
- solving for optimum material substitutions using said mathematical expressions.